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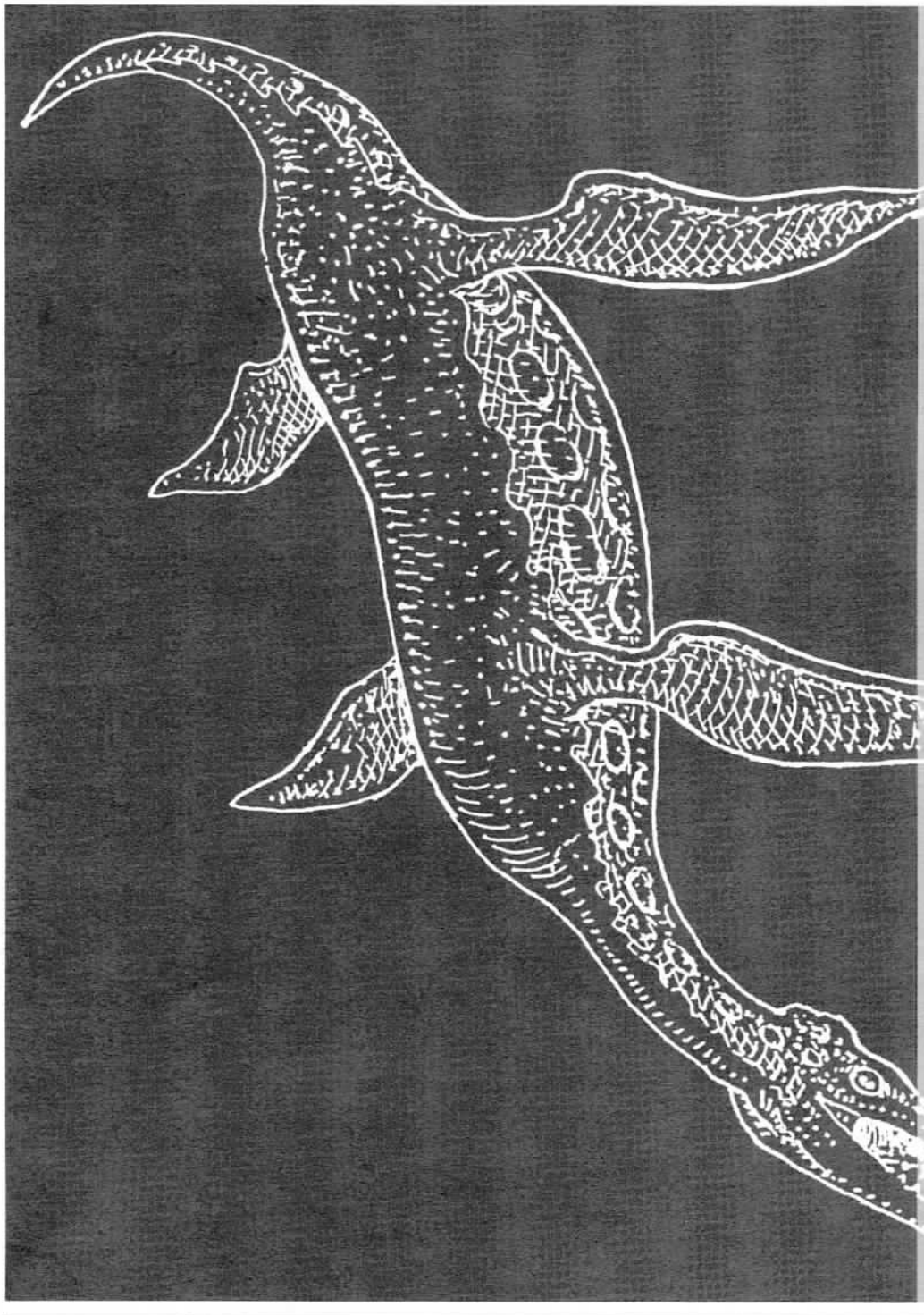

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ARTICLE

# Sea-monster or Shark? An Analysis of a Supposed Plesiosaur Carcass Netted in 1977

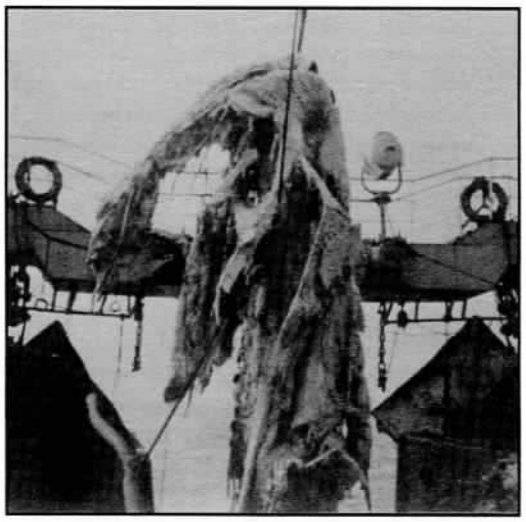
*Glen J Kuban*

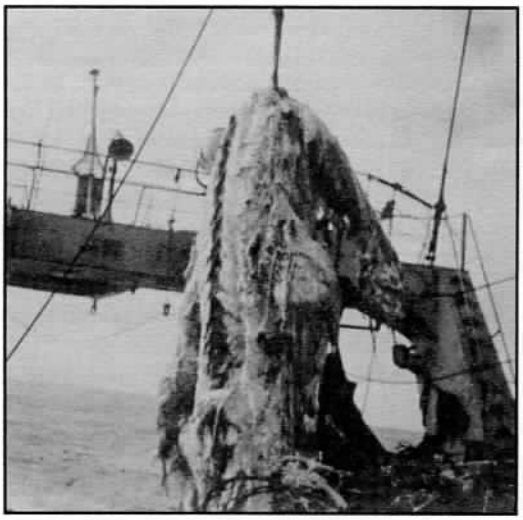
Plesiosaurs were a group of long-necked, predatory marine reptiles with four paddle-like limbs thought to have gone extinct with the dinosaurs about 65 million years ago. A decayed carcass accidentally netted by a Japanese trawler near New Zealand in 1977 has often been claimed by creationists and others to be a likely plesiosaur or prehistoric "sea-monster". However, several lines of evidence, including lab results from tissue samples taken from the carcass before it was discarded, strongly point to the specimen's being a shark, and most likely a basking shark. This should not be surprising, since basking sharks are known to decompose into "pseudoplesiosaur" forms, and their carcasses have been mistaken for "sea-monsters" many times in the past. Unfortunately, the results of scientific studies on the carcass data received less media attention than the early sensational reports, allowing widespread misconceptions about this case to continue circulating. Therefore, a thorough review of its history and the pertinent evidence is warranted.

**On April 25, 1977, a fishing vessel named the Zuiyo-maru...was trawling for mackerel..., when a large animal carcass became entangled in its nets.**

## A Mystery At Sea

On April 25, 1977, a fishing vessel named the Zuiyo-maru of the Taiyo Fishery Company Ltd was trawling for mackerel about 30 miles east of Christchurch, New Zealand, when a large animal carcass became entangled in its nets at a depth of about 300 meters (almost 1000 feet). As the massive creature, weighing about 4000 pounds, was drawn toward the ship and then hoisted above the deck,





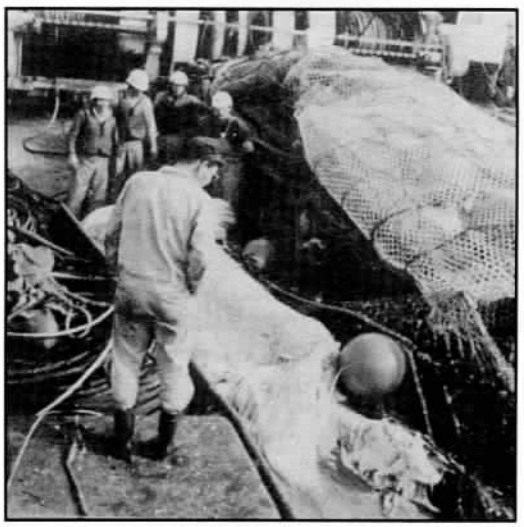


*Figure 1.*

*Three of the photographs taken by Michihiko Yano aboard the Zuiyo-maru on April 25, 1977.*

*A. Front view of the carcass. This view inspired many to view the carcass as plesiosaur-like.*

*B. The only clear photograph of the back of the carcass, showing an apparent dorsal fin and myocommata along the spine (see Figure 5).*

*C. The carcass on the deck, with the anterior end toward the right.*

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assistant production manager Michihiko Yano announced to the captain, "It's a rotten whale!" However, as Yano got a better look at the creature, he became less sure. About 17 other crew members also saw the carcass, some of whom speculated that it might be a giant turtle with the shell peeled off. However, no one on board could say for sure what it was (Aldrich 1977; Koster 1977).

Despite the possible scientific significance of the find, the captain and crew agreed that the foul-smelling corpse should be thrown overboard to avoid spoiling the fish catch. However, as the slimy carcass was being maneuvered over the ship in preparation for disposal, it slipped from its ropes and fell suddenly onto the deck. This allowed the 39 year-old Yano, a graduate of Yamaguchi Oceanological High School, to examine the creature more closely. Although he was still unable to identify the animal, Yano felt it was definitely unusual, prompting him to take a set of measurements, along with five photographs using a camera borrowed from a shipmate (see Figure 1). The carcass measured 10 meters (about 33 feet) in length. Yano also removed 42 pieces of "horny fiber" from an anterior fin, in hopes of aiding future identification efforts. The creature was then released over the side and sank back into its watery grave. All of this took place within about an hour (Koster 1977). About two months later Yano made a sketch of the carcass, which unfortunately conflicts with some of his own measurements, photographs, and earlier statements (see Figure 2).

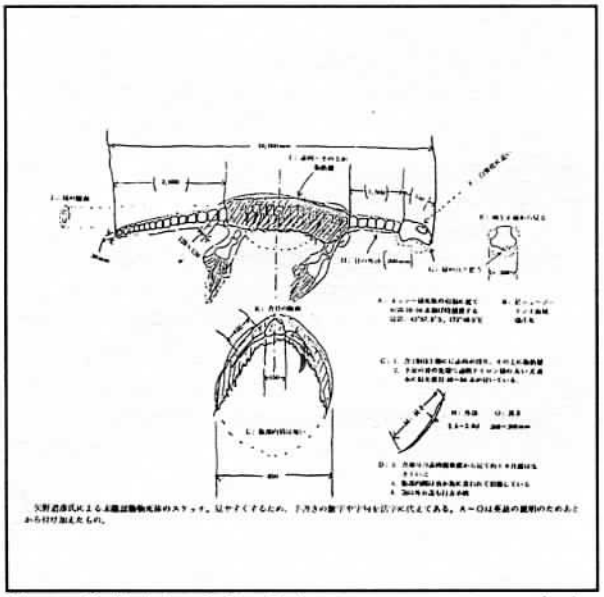


*Figure 2. Sketch of the Zuiyo-maru carcass, made by Michihiko Yano two months after carcass was examined and thrown overboard. Sketch and translations appeared in the* Collected papers on the carcass of an unidentified animal trawled off New Zealand by the Zuiyo-maru. *Major body segment measurements in the drawing: Overall length: 10 000 mm; head length: 450 mm; neck length: 1500 mm; tail length: 2000 m. Also available at <http://members.aol.com/paluxy2/plesios.htm>.*

When Yano returned to Japan on a different boat on June 10th, 1977, he promptly had his photos developed in the fishery's darkroom. Company executives were fascinated with the photos, some of which did appear to show an unusual animal with a long neck and small head. Local scientists looked over the photos and remarked that they had never seen anything like it (Koster 1977). Some speculated that it might be some kind of prehistoric creature such as a plesiosaur.

On July 20, 1977, as excitement and speculation about the find began to spread, officials from the fish company held a press conference to announce their mysterious discovery. Although scientific analysis of the tissue samples and other data had not yet been completed, company representatives played up the sea-monster angle. The same day several Japanese newspapers published sensational front-page accounts of the find, soon followed by many other radio and television stories throughout Japan (Sasaki 1978).

## Preliminary Interpretations

Although some Japanese scientists remained cautious, others encouraged the plesiosaur idea. Professor Yoshinori Imaizumi, director of animal research at Tokyo National Science Museum, was quoted in the *Asahi Shimbun* newspaper as saying, "It's not a fish, whale, or any other mammal.... It's a reptile, and the sketch looks very like a plesiosaur. This is a precious and important discovery for human beings. It seems to show these animals are not extinct after all" (Koster 1977). Tokio Shikama of the Yokohama National University also supported the monster theme, "It has to be a plesiosaurus. These creatures must still roam the seas off New Zealand feeding on fish." (Wire service reports, 7/25/77, reported in Aldrich 1977).

**Even if a living plesiosaur were confirmed, it would not threaten the theory of evolution.**

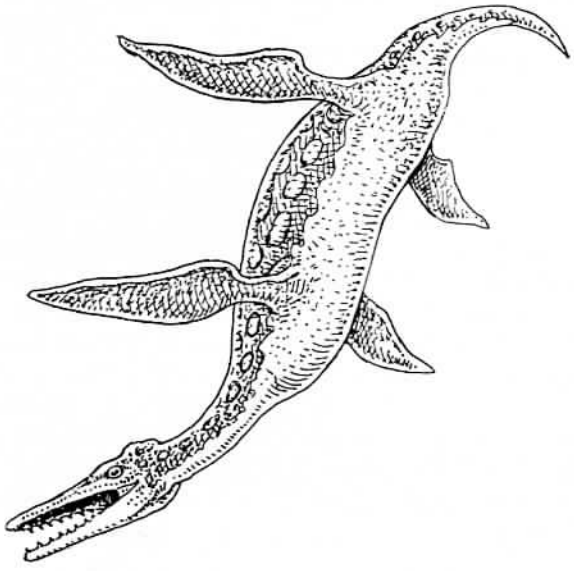
Meanwhile, American and European scientists interviewed about the carcass mystery generally downplayed the sea-monster theory, as reported by a number of newspapers and wire services (*Denver Post*, 7/21/77; *Washington Post*, 7/22/77; *Boston Globe*, 7/22/77); *New York Times*, 7/24/77; UPI, 7/24/77; *New Scientist* 7/28/77). Paleontologist Bob Schaeffer at the American Museum in New York noted that every ten years or so a carcass is claimed to be a "dinosaur" but always turns out to be a basking shark or adolescent whale. Alwyne Wheeler of the British Museum of Natural History agreed that the body was probably a shark. Explaining that sharks tend to decompose in an unusual manner, Wheeler added, "Greater experts than the Japanese fishermen have been foiled by the similarity of shark remains to a plesiosaur."

Other western scientists offered their own interpretations. Zoologist Alan Fraser-Brunner, aquarium curator at the Edinburgh Zoo in Scotland, suggested the body was a dead sea lion (Koster 1977), despite the creature's immense size. Carl Hubbs, of the Scripps Institute of Oceanography in La Jolla, California, felt it was "probably a small whale...so rotten that most of the flesh was sloughed off." George Zug, curator of reptiles and amphibians at the Smithsonian Institute, proposed that the creature was a decayed leatherback turtle (Aldrich 1977). The divergence among early scientific opinions in this case might be partly due to the fact that many biologists and zoologists are used to working with complete, fresh specimens rather than badly decomposed carcasses (or worse, photos of such), in which both external and internal organs can be quite different from their appearance in living animals (Obata and Tomoda, p 46).

**The combined anatomical evidence thus strongly indicates a shark and effectively rules out a plesiosaur.**

On July 25, 1977, Taiyo Fish Company issued a preliminary report on biochemical tests (using ion-exchange chromatography) on the tissue samples. The report stated that the horny fiber sampled from the carcass was "similar in nature to the fin-rays, a group of living animals". The "living animals" referred to were sharks; however, the report failed to state this plainly, leading to further confusion by the Japanese media (Sasaki 1978) and the continued spread of monster mania.

Toy manufacturers began gearing up to make wind-up models of the beast, while the company which made Yano's borrowed camera developed a whole advertising campaign around his "sea-monster" photos. Dozens of fishing vessels from Japan, Russia, and Korea were reportedly streaming toward New Zealand in hopes of resnagging the hastily discarded creature. Bubbling with excitement, one Japanese citizen confided that he thought sea-monsters were imaginary creatures but "danced when I read in the newspaper that it was still alive!" (Koster 1977). The Japanese government even issued a new postage stamp featuring a picture of a plesiosaur. Not since Godzilla had a monster so overtaken Japan.



The carcass controversy continued to make appearances in the popular press in America, but with less sensationalism. On July 26, 1977, *The New York Times* reported that professor Fujio Yasuda, who initially promoted the idea that the carcass resembled a plesiosaur, acknowledged that initial chromatography tests showed a profile of amino acids closely resembling a control sample from a blue shark. Meanwhile, Dr. Zug of the Smithsonian Institution had changed his interpretation from a turtle to a basking shark after further examining the carcass photos (*INFO Journal* Nov/Dec 1977). An August 1, 1977 *Newsweek* article briefly discussed the "South Pacific Monster" without taking sides. A few months later a more detailed article by John Koster (1977) appeared in *Oceans* magazine. This account was evidently the basis for many subsequent reports, many of which embellished or oversimplified various aspects of the story. Koster mentioned the preliminary tissue results and comments by western scientists supporting the shark interpretation, but also quoted Yano and others suggesting that the issue was not yet settled. Koster himself suggested that the small size of the creature's head, well-defined spinal column, and the lack of dorsal fin, did not fit the shark identification.

## Creationists Seize the Monster

Soon news of the controversial carcass also came to the attention of some strict creationists, who suggested that the "likely plesiosaur" supported their young-earth position (Swanson 1978; Taylor 1984; Peterson 1988). After all, they seemed to imply, if a creature supposedly extinct for millions of years can turn up in a fishing net, how can we trust anything geologists tell us?

However, even if a living plesiosaur were confirmed, it would not threaten the theory of evolution. After all, many other animal groups represented by modern species co-existed with the dinosaurs during the Mesozoic Era, such as crocodiles, lizards, snakes, and various fishes. Most of these groups are well represented in the fossil record leading to the present time, but some creatures, such as the Coelacanth and Tautara, were once thought to have been extinct for tens of millions of years, only to be later found alive and little changed in modern times. These cases emphasize the incompleteness of the fossil record and the remarkable stasis of some animal groups, but are not grounds for upheavals in evolutionary thought. Nevertheless, the discovery

of a modern plesiosaur would certainly be a stupendous scientific find in its own right, confirming that long-necked "sea serpents" were not just long-extinct creatures or the stuff of sailors' myths, but real "living fossils". Unfortunately, a more thorough examination of the evidence would convincingly refute the plesiosaur interpretation.

## Monstrous Tendencies of Basking Sharks

A number of scientists thought it likely from the start that the carcass in question was probably a shark, based on their knowledge of basking shark decay, and similar "sea serpent" carcass incidents of the past. The basking shark, *Cetorhinus maximus*, is the second largest fish in the sea (surpassed only by the whale shark). It can grow to more than 10 meters in length, and longer specimens have been reported (Soule 1981; Freedman 1985; Dingerkus 1985). However, this gentle giant is harmless to humans. It feeds by filtering plankton (mostly tiny crustaceans) through its large gill rakers as it swims lazily just under the water's surface with huge mouth agape.

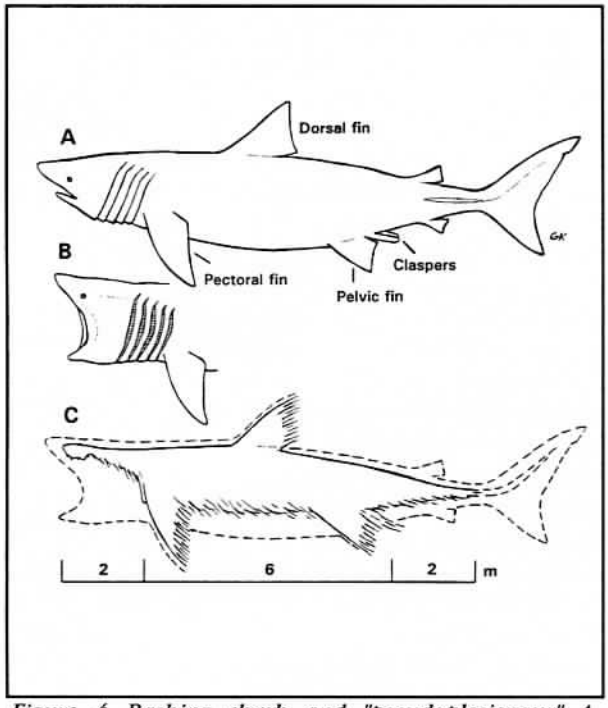



*Figure 4. Basking shark and "pseudoplesiosaur" A. Basking shark in closed-mouth profile. B. Basking shark while feeding. C. Decomposed basking shark presenting a plesiosaur-like shape. Scale bar shows that a 10-meter basking shark carcass with tail lost would have essentially the same body proportions as those indicated in the Zuiyo-maru carcass (Figure 2). The carcass head and neck combined were measured at 1.95 m long and the tail 2.0 m, making the unmeasured torso (mid section) 6.05 m by calculation.*

When the basking shark decays, the jaws and loosely attached gill arches often fall away first, leaving the appearance of a long neck and small head (see Figure 4). All or part of the tail (especially the lower half which lacks vertebral support) and/or the dorsal fin may also slough away before the better-supported pectoral and pelvic fins. This results in a form that superficially resembles a plesiosaur (Huevelmans 1968; Burton and Burton 1969; Cohen 1982; Bright 1989; Ellis 1989). Some have called such remains "pseudoplesiosaurs" (Cohen 1982), although one might also dub them "plesiosharks".

According to renowned cryptozoologist Bernard Heuvelmans (1968), over a dozen supposed "sea serpent" carcasses of years past were later shown to be definite or probable shark carcasses–in most cases basking sharks. These include (but are not limited to), the famous "Stronsa Beast" of Orkney Islands, England (1808), the Raritan Bay carcass of New Jersey (1822), the Henry Island, British Columbia carcass (1934) and the Querqueville monster, France, also in 1934. These were followed by the Hendaye carcass in France (1951), the New South Wales carcass (1959), and two more cases in 1961 (Vendee, France, and Northumberland, England). In 1970 another supposed "monster" washed up at Scituate, Massachusetts. This 30-foot beast was said to look remarkably like a plesiosaur; however, it also turned out to be a decayed basking shark (Cohen 1982; Bright 1989). In 1996 yet another supposed sea serpent was stranded on Block Island, RI. Nicknamed the "Block Ness Monster", it too has been evaluated as a probable basking shark (Roesch 1996).

**Unfortunately, the 1978 scientific reports received less public attention than the original "sea-monster" stories.**

Interestingly, basking sharks seem to have a propensity to mimic sea serpents while alive as well as dead. Often they feed in groups floating at or near the surface (hence the name "basking" sharks) and sometimes line up two or more in a row. When they do this, the dorsal and tail fins protruding from the water can be (and sometimes are) mistaken for the multiple "humps" and head of a long-bodied sea-monster (Sweeney 1972; Bright 1989; Ellis 1989; Perrine 1995).

## Scientific Study of the Carcass

By the time the *Oceans* article was going to press, scientists in Japan had already formed a research team to study the Zuiyo-maru case more closely. Copies of the carcass photographs had reached scientists at the Tokyo University of Fisheries, including its president Dr. Tadayoshi Sasaki who proposed a meeting of scientists to study the available data. Initial meetings were held on September 1 and September 19, 1977, and attended by over a dozen scientists, including specialists in biochemistry, ichthyology, paleontology, comparative anatomy, and other fields. The workers agreed to avoid publicizing their individual conclusions until the study was completed (Sasaki 1978). In July 1978 a collection of nine papers presenting the team's

findings was published in a report by the Société Franco-Japonaise d'Océanographie. Despite some disagreements over specific items of evidence and the view of some workers that the identification was still uncertain, the majority opinion was that the carcass was a badly decomposed shark—most likely a basking shark (Sasaki 1978). This conclusion was strongly supported by several lines of evidence, including studies on the microscopic appearance, chemical composition and physical properties of the tissue samples, as well as a number of anatomical considerations, elucidated below.

## Tissue Sample Evidence

The horny fibers sampled from the carcass were rigid, needle-like structures that tapered toward both ends and had a translucent light-brown color (Kimura and others 1978, p 68). Such features are characteristic of ceratotrichia—the cartilaginous fibers of shark fin rays. Abe (1978) found that the carcass fibers and known ceratotrichia from a basking shark "resembled each other remarkably".

Gross amino acid analysis of the carcass samples gave results that closely matched elastoidin from a known basking shark. Elastoidin is a collagenous protein known only from sharks and rays (not reptiles or even other fish). The match was especially impressive when known basking shark elastoidin was treated with an antiseptic sodium hypochlorite

**Abundance of Specific Amino Acid Residues per 1000 in "Plesiosaur" and Basking Shark**

| Amino Acid | 1977 Carcass Sample | Known Sample of Basking Shark Elastoidin |
|---|---|---|
| 4-Hydroxyproline | 45 | 45 |
| Aspartic/acid | 54 | 55 |
| Threonine | 25 | 25 |
| Serine | 39 | 40 |
| Glutamic acid | 80 | 80 |
| Proline | 130 | 125 |
| Glycine | 291 | 290 |
| Alanine | 109 | 110 |
| Cystine (1/2) | 7 | 6 |
| Valine | 25 | 24 |
| Methionine | 10 | 10 |
| Isoleucine | 20 | 20 |
| Leucine | 19 | 19 |
| Tyrosine | 43 | 41 |
| Phenylalanine | 12 | 12 |
| Hydroxylysine | 5 | 6 |
| Lysine | 25 | 26 |
| Histidine | 11 | 13 |
| Arginine | 51 | 53 |
| (Amide-N) | (57) | (62) |

Table 1. Results of gross amino acid analysis on the horny fiber from the 1977 Zuiyo-maru carcass and known elastoidin of a basking shark (residues/1000 residues). Composition was determined by JLC-3BC liquid chromatography (JEOL Co. Ltd.). Both samples had been treated with NaClO. (Kimura, Fujii, and others 1978).

# Alan Charig, 1927-1997

*John R Cole*
*Contributing Editor*

Alan J Charig, British Museum paleontologist and dinosaur researcher, died July 15, 1997 in Oxford, England at age 70. Charig was a widely renowned field paleontologist who excavated—and popularized—dinosaurs on four continents. He also discovered one of the oldest known mammal fossils in Lesotho and the earliest herring fossils (the latter in Australia). NCSE members may know him best as the author of the *Science* article in 1986 which overwhelmingly refuted the claim that *Archaeopteryx* fossils were 19th-century forgeries. His 4000 word article was a masterpiece of debunking and dissection of the claim advanced by astronomers Fred Hoyle and Chandra Wickramasinghe, two anti-Darwinists (although not anti-evolutionists) who have continued to be cited occasionally by "scientific" creationists as offering "proof" that the famous transitional fossils were fakes. Charig's critique was devastating enough that most creationists have long since reverted to the claim that the fossil is "just a bird"—that is, unimportant and uninteresting except to benighted evolutionists. The hoax claim was laid to rest so thoroughly that Charig apologized for "using a sledgehammer to crack a rather trivial nut." The hammer was important and appreciated, however.

# Ralph Wendell Burhoe Dies at 85

*John Cole*
*Contributing Editor*

Ralph Wendell Burhoe died May 8, 1997, after an amazing career in science and theology. Largely self-educated, Burhoe first made his name in meteorology in the 30s, but soon his attention turned to issues of the 20th-century state of science, religion and technology. As executive officer of the American Academy of Arts and Sciences from 1947 to 1964, he was instrumental in founding their journal *Daedalus*. He then taught at Meadville Theological Seminary in Chicago until retiring in 1974. He co-founded the Chicago Center for Religion and Science in 1988, in collaboration with the Lutheran School of Theology. For many years he was editor of *Zygon: Journal of Religion and Science*, and in 1989, Burhoe, a Unitarian, became the first American winner of the new Templeton Prize for Progress in Religion. Friends and critics alike considered him the foremost 20th-century mover in efforts to reconcile religion and science, and evolution was one of his longtime favorite interests. The Templeton citation said that the pro-science "reformation" he led may be far more profound and revolutionary than the Reformation led by Martin Luther.

(NaClO) solution, as were the Zuiyo-maru samples (Obata and Tomoda 1978, p 52; Omura, Mochizuki, and Kamiya 1978, p 58). The correspondence was virtually identical on all 20 amino acids tested (Table 1). In discussing this "striking similarity," Kimura and colleagues (1978, p 72) noted that a statistical test called the "difference index (DI)" gave an extremely low value indicating a tight match. They also noted that the high tyrosine content (43 and 41 residues for the samples, respectively) is especially characteristic of shark elastoidin as compared with collagens from other species which typically have 5 or fewer tyrosine residues.

Furthermore, the horny fibers from the fin showed a distinctive shrinking to about 1/3 the original size when heated in water to 63° C, and gradually re-elongated upon cooling. This unique hydrothermal behavior is characteristic of elastoidin (Kimura and others 1978, p 68).

Electron micrographs of the tissue showed numerous parallel protofibrils, along with a particular banding pattern that is characteristic of shark elastoidin. Micrographs also revealed a major periodic striation pattern of 450-500 angstroms, which is shorter than typical collagens, but which was previously observed in basking shark elastoidin (Kimura and others 1978).

Earlier gas chromatography analysis on the horny fibers gave results consistent with shark tissue (Sasaki 1978). Kimura and colleagues (1978) concluded that the composite tissue sample studies indicated that the horny fiber was essentially identical to known basking shark elastoidin in both its morphology and amino acid composition. They remarked, "If the horny fiber was pulled out from an animal belonging to other classes except Chondrichthyes [sharks and relatives], it should be significantly different.... These results strongly suggest that this unidentified creature is a basking shark or closely related species" (Kimura and others 1978, p 73).

## ANATOMY

Yano's sketch of the carcass (Figure 2) showed six neck vertebrae, viewed as "seven or so" by Obata and Tomoda (1978), which is reasonably consistent with Yano's measurements of neck length (150 cm) and individual vertebral size (20 cm). It is also consistent with the number of neck vertebrae in sharks. However, 6 to 7 cervical vertebrae are too few for plesiosaurs and other marine reptiles. Even the pliosaurs, also known as "short-necked" plesiosaurs, have at least 13 neck vertebrae; the "long necked" plesiosaurs have far more. (Obata and Tomoda 1978, p 46).

The head of the creature was reported to be turtle-like (Obata and Tomoda 1978, p 48). This is consistent with the known cranial remains of basking sharks which have been specifically described as resembling a turtle head (Omura, Mochizuki, and Kamiya 1978, p 59). In contrast, plesiosaurs had more triangular-shaped heads that were not particularly turtle-like (Hasegawa and Uyeno 1978, p 64).

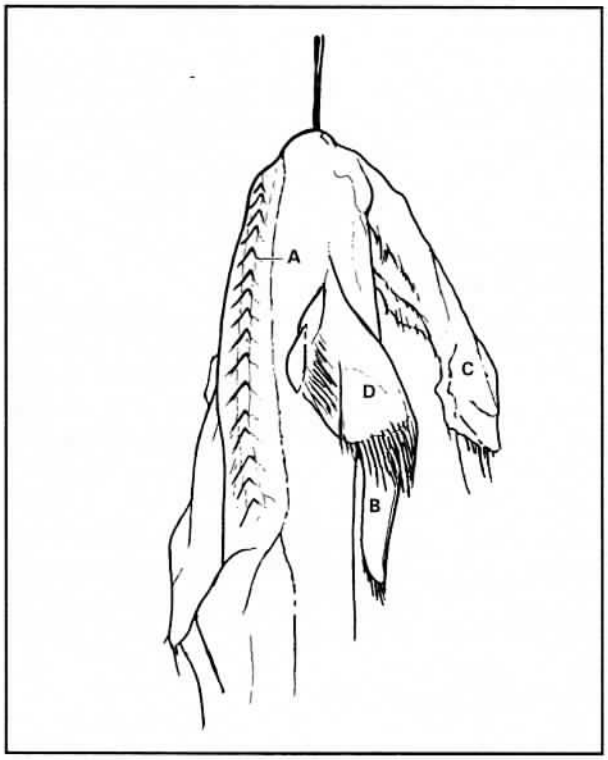



*Figure 5. Interpretive drawing of the photograph in Figure 1b. A. Myocommata. B. Right forelimb. C. Cranium D. Dorsal fin. Compare to Figure 1b.*

**Gross amino acid analysis of the carcass samples gave results that closely matched [cartilage] from a known basking shark.**

Photographs and witnesses confirm the presence of fin rays, which are possessed by most fish, including sharks. In contrast, plesiosaurs had bony phalanges as flipper supports, and no bones were seen in the carcass's fins (Obata and Tomoda 1978, p 51). The limb bones shown in Yano's drawing were evidently based largely on presumption or pro-plesiosaur bias rather than observation (Omura and others 1978, p 56; Obata and Tomoda 1978, p 49). One of the photos (Figure 1b) shows an apparent dorsal fin (see Figure 5). Dorsal fins are possessed by most fish including sharks, but are thought to have been lacking in plesiosaurs.

The V-shaped structures along the vertebral column (Figures 1b and 5) and near the pectoral girdle (Figure 1a) were identified as myocommata by Omura and colleagues (1978, p 56-7). Myocommata are composed of strong connective tissues between muscle segments known as myomeres, which are found in sharks but not reptiles. Yano measured the ribs as 40 cm (about 16 inches) long, which is far too short for plesiosaurs or other marine vertebrates except sharks (Hasegawa and Uyeno, p 65).

be too long for a shark, which typically have very small ribs. But this was an exceptionally large specimen and was probably even larger before decomposition. Also, it is not certain that Yano accurately identified or measured the ribs, which do not appear in the photos. Perhaps he mistakenly measured remnant gill arches, myocommata, or muscle furrows, under the assumption that they corresponded to ribs.

In Yano's photos the anterior fins appears to join the shoulder at a right angle, consistent with sharks but not plesiosaurs (Obata and Tomoda 1978, p 46; Hasegawa and Uyeno 1978, p 65). The pectoral girdle is visible between the front fins in Figure 1a and appears broken, but shark-like in shape (Compagno 1997; Phelps 1997; Roesch 1997b).

**For more information on Basking Sharks, see: The Basking Shark Project <http://www.isle-of-man.com/interests/shark/>.**

**Fact Sheet: The Basking Shark <http://www.mbl.edu/html/MISC/basking.html>.**

**For web sites and internet mailing lists on sharks, Ben Roesch's Shark Links <http://www.ncf.carleton.ca/~bz050/HomePage.sharklinks.html>.**

If the carcass were a plesiosaur, the body would be unlikely to bend in the posture shown in some of the photographs, since the breast bone would be large and flat. Likewise, the other ventral (belly-side) bones of plesiosaurs, which should have remained if the anterior fins were preserved, are not seen in the carcass (Hasegawa and Uyeno 1978, p 64). In plesiosaurs, bones of all limbs connect to their girdles on the ventral portion of the body; therefore, if the creature were a decayed plesiosaur, it is likely the limbs would have already been detached from the body (Hasegawa and Uyeno 1978, p 63).

At the existing degree of decomposition, a plesiosaur would probably have retained its upper jaws and teeth (Hasegawa and Uyeno 1978, p 63), but no teeth were reported in the specimen carcass (Obata and Tomoda 1978, p 48). A basking shark, however, is known to lose both jaws easily, and even if it retained the upper jaw, its extremely tiny teeth could be easily overlooked.

Yano reported the total carcass length as 10 meters (33 feet). Basking sharks commonly grow to 30 feet (Dingerkus 1985; Freedman 1985), and longer specimens have been reported (Heuvelmans 1968; Herald 1975; Soule 1981; Steel 1985). Some authors indicate they may even grow to 50 or more feet (Springer and Gold 1989; Perrine 1995; Allen 1996). Although the size of this carcass would be compatible with a small plesiosaur, the body *proportions* are not.

Although some of Yano's measurements seem surprisingly round (for example, 2 000 mm for the tail and 10 000 mm total length), they may be taken as reasonably accurate, since they appear compatible with the photos. Indeed, both the photos and measurements indicate a torso much longer than that indicated in the sketch. Although the 1978 authors demonstrated that the reported carcass proportions do not fit a plesiosaur, they surprisingly neglected the key question of whether the proportions are more compatible with a basking shark. As it turns out, they are, especially if the shark had lost its tail through decay (see Figures 2 and 5). Loss of the tail would be likely, since the wide tail would tend to snap at the narrow juncture between the tail fin and the rest of the body due to decay and buffeting in the water. This would explain the blunt rather than tapering tail end in Yano's sketch. The rostrum (nose tip) may also have been lost, but would not appreciably affect the overall body length or proportions. Adding a tail would mean the shark was closer to 12.5 meters (41 feet) in life, which would be exceptionally large, but still within the generally accepted size range of basking sharks. After all, this poor basker may have died of old age.

The combined anatomical evidence thus strongly indicates a shark and effectively rules out a plesiosaur. Obata and Tomoda (1978, p 52) conclude, "there are no known fossil reptilian species that agree with the animal under consideration." Likewise, Hasegawa and Uyeno (1978, p 64) write, "From the osteological point of view, we conclude that this creature does not belong to the plesiosaurian reptiles."

## Miscellaneous Observations

Japanese shark-fin processors, who are thoroughly familiar with shark carcasses, identified the animal in Yano's photographs as a shark (Abe 1978). In September 1977 a positively-identified basking shark carcass was stranded at Nemuro, Hokkaido, and showed a remarkable resemblance to the Zuiyo-maru carcass found only five months earlier. Describing the September stranding Omura, Mochizuki, and Kamiya (1978, p 59-60) wrote, "The jaws and gill-arches were missing, and the cranium had a somewhat turtle-like appearance...the pectoral and pelvic fins were damaged at their apexes but still remained. The results of this experiment undertaken by nature support the view that the Zuiyo-maru carcass was a giant shark that has lost its jaws and gill arches." Summarizing their findings, Hasegawa and Uyeno (1978) state, "Based on available evidence, we are convinced that this New Zealand creature is not the "New Nessie" that much of the world was hoping for, but more than likely a carcass belonging to a large size shark."

## Alleged Inconsistencies

Despite all the evidence pointing to a shark, some purported inconsistencies with the shark

identification were raised in the 1978 report and elsewhere and should be reviewed as well. The carcass reportedly smelled like a dead marine mammal compared to the ammonia smell characteristic of shark carcasses (Hasegawa and Uyeno 1978, p 65). However, it is not known whether all sharks give off the ammonia smell while decaying or for how long. The same authors noted that the lack of ammonia smell could be due to the extent of skin loss and decomposition, so that the ammonia from the carcass was diluted or washed out by seawater (Hasegawa and Uyeno 1978, p 65). Furthermore, even when alive basking sharks are known to emit a unique, highly offensive odor of their own (Steel 1985; Ellis 1989) which could have overpowered any ammonia smell.

A white, sticky, fat-like substance covered much of the carcass (Obata and Tomoda 1978, p 49). Although Niermann (1994, p 103) and a few others (Hasegawa and Uyeno 1978) considered this the strongest argument against the shark theory, it is actually consistent with it. Basking sharks have large deposits of fat in the white muscle and liver. According to some authorities they increase fat reserves during the summer for winter use (Steel 1985; Sims 1997). The animal in question likely died in late March or early April, which is late summer in New Zealand. Moreover, one of the Japanese workers (Seta 1978) explained the phenomenon of adipocere (post-mortem fat) formation in decaying carcasses of sharks and other animals, whereby new fatty material can be generated during the decay process. Seta indicated that the whitish, putrid-smelling viscous substance on the carcass was consistent with adipocere formation. Some of the whitish, stringy material also probably consisted of ligaments and connective tissue (Omura, Mochizuki, and Kamiya 1978, p 56). Such fibrous tissues on other basking shark carcasses evidently prompted some reports of "sea monster" corpses with white manes of hair (Heuvelmans 1968; Sweeney 1972).

The photographs reportedly show the presence of reddish muscle under the white material, which Obata and Tomoda (1978, p 49) suggest is compatible with a tetrapod (four-limbed animal). However, the presence of reddish muscle is also compatible with a shark. Like other fishes sharks have both white and red muscle (Fowler 1997; King 1997; Sims 1997). The former predominates, but fishes that swim slowly and steadily like basking sharks generally have more red muscle than other sharks (Tullis 1997). Some of the reddish color also could be due to blood residue.

The concerns of some authors about the "small head" or "long neck" (Koster 1977, Yasuda and Taki 1978) are eliminated once one understands the process of decay in basking sharks. Summarizing this process, Omura, Mochizuki, and Kamiya (1978, p 59) wrote, "...a disproportionately small skull and long, slender neck can be accounted for by the loss of the jaws and gill-arches in the course of decomposition of the carcass."

Obata and Tomoda (1978, p 48) also suggest that unlike sharks, in which the nares (nostrils) are situated in the lower surface of the skull, the carcass had holes that Yano called "probably nares" at the front end of the cranium. However, the rostrum or anterior most structure may have been missing, so that the nares could have been on the lower side and also the "front" of what remained of the skull, eliminating any inconsistency. Alternatively, what Yano thought to be nares could have been any of several other fenestral openings that exist in shark skulls, or new ones created during decay.

Some witnesses denied the presence of a dorsal fin (Obata and Tomoda 1978). However, even if a dorsal fin were absent, it could have been rotted away. Second, as mentioned, one photo does show an apparent dorsal fin (see Figures 1b and 5) which was evidently overlooked by Yano and others. Omura, Mochizuki, and Kamiya (1978, p 56) wrote, "...by a close examination of the photograph we can clearly distinguish the base of a dorsal fin, though it had slipped from the mid-dorsal line."

**The divergence among early scientific opinions in this case might be partly due to the fact that many biologists... are used to working with complete, fresh specimens rather than badly decomposed carcasses.**

Obata and Tomoda (1978, p 49) suggest that the "long, cylindrical ribs" in the carcass are not found in selachians. However, as explained earlier, it is not certain that Yano accurately identified or measured the ribs. Even if he did, the rib length (40 cm) is more compatible with a large shark than a plesiosaur. If the creature were a plesiosaur, it would have had to be a short-necked plesiosaur whose ribs would be at least triple the reported length (Martin 1997).

The head was said to be quite hard, whereas sharks contain no bones, only cartilaginous skeletons. However, cartilage in shark skulls can be quite hard and dense, and basking sharks have especially well-calcified skeletons (Steel 1985). As a shark ages, its skull becomes harder and denser. The size of the carcass clearly indicates an older specimen.

The pelvic (hind) fins were said by some of the crewmen to be similar in size to the pectoral fins, as in a plesiosaur (Obata and Tomoda 1978, p 49). However, this cannot be confirmed, since no measurements or photos were taken of the pelvic fins. Yano and others may have mistaken the large, draping and dislocated dorsal fin for one of the other fins (Hasegawa and Uyeno 1978, p 62); or, the combination of the pelvic fins and rear genital claspers may have created the illusion of a sizable rear fin

(Hasegawa and Uyeno 1978, p 63). This might explain Yano's comment that the rear fins had an unusual appearance like that of a seal (Koster 1977).

It is also possible that the pectoral fins decayed somewhat more than the pelvic fins, reducing their size disparity. Yano himself acknowledged that to the best of his recollection the front fins were somewhat larger than the rear (Koster 1977). His sketch suggests otherwise, but it is known to contain a number of other inaccuracies, such as bones in the fins that were not really seen. Noting such problems, Yasuda and Taki (1978) considered the sketch inherently unreliable, and Obata and Tomoda (1978) suggest it was influenced by bias. Indeed, by the time Yano drew the sketch (two months after the netting) the plesiosaur idea had become popular, and Yano had become something of a celebrity over it (Koster 1977).

**Although scientific analysis of the tissue samples and other data had not yet been completed, company representatives played up the sea-monster angle.**

Some readers may be wondering if the location of the find was a problem for the basking shark identification (as hinted in Yasuda and Taki 1978). However, basking sharks are known from many temperate parts of the world, including the waters around New Zealand (Burton and Burton 1969; Springer and Gold 1989; Francis 1997). The carcass was thought to have died in an area somewhat south of the capture site, well within the known range of basking sharks (Nasu 1978).

## Monsters Don't Die Easily

Overall, the 1978 reports provided strong evidence favoring the shark identification and no substantial objections to it. Even authors such as Obata and Tomoda, who initially supported the plesiosaur idea and emphasized potential problems for the shark interpretation, acknowledged that most evidence pointed to a shark and ruled out a plesiosaur. They concluded "There are no known fossil reptilian species which agree with the animal in question" (Obata and Tomoda 1978). Most of the other authors in the 1978 reports more plainly stated that the evidence strongly indicated a basking shark or closely related species (Abe, 1978; Hasegawa and Uyeno 1978; Omura and others 1978; Kimura and others 1978).

Unfortunately, the 1978 scientific reports received less public attention than the original "sea-monster" stories. Most popular media seemed content simply to let the matter drop rather than helping to set the matter straight with follow-up articles. Likewise, several monster/mystery writers continued to depict the case as largely unresolved, including Welfare and Fairley (1980), Soule (1981), and Bord and Bord (1989). However, some good summaries of the 1978 research were provided by Cohen (1982), Cave (1988), Bright (1989), LeBlond (1992), and Ellis (1994) who put aside any hopes that the beast was a plesiosaur, and properly explained that the specimen evidently represented one of several basking shark carcasses mistaken as a sea-monster.

Even more disappointing, many creationists continued to promote the plesiosaur interpretation long after 1978, including Ian Taylor (1987, 1989, 1996), Paul Taylor (1985, 1987), Peterson (1988), Baker (1988), Dye (1989), Bartz (1990, 1992), Buckna (1993), Morris (1993, 1997), and Brown (1995). Most seemed unaware of the 1978 research and reports. Some flatly called the beast a plesiosaur (Scoggan 1996; Hovind 1996), or "sea-monster" (Doolan 1994), or "dinosaur" (Hovind 1996); plesiosaurs are *not* dinosaurs. Some creationists also included a redrawn and significantly altered version of Yano's drawing, making an already inaccurate sketch even less reliable and more plesiosaur like (Taylor 1987; Doolan 1991).

Still more perplexing were the comments of creationists who did seem aware of the 1978 work and tissue tests, and yet suggested they supported the plesiosaur identification. Among the most troubling statements are the following:

- From photographs, sketches with careful measurements, and flipper samples for tissue analysis, it had every appearance of being a plesiosaur or sea-dwelling dinosaur... (Ian Taylor 1984, 1978).
- Photographs, measurements, and tissue samples all show that it was probably a plesiosaur (Paul Taylor 1987).
- Photographs, tissue examinations, and measurements were made by the Japanese scientists. Their findings point to a descendant of the plesiosaur (Baker 1988).

Some creationists even complained that the press was suppressing the plesiosaur story (Doolan 1991; Bartz 1992; Scoggan 1996; Taylor 1996), despite its coverage in dozens of popular books and articles, and the fact that it was often presented in a way more favorable to the plesiosaur interpretation than the evidence warranted.

Recently two creationists have written more accurate but still incomplete summaries of the case. Niermann (1994) noted that the 1978 studies pointed to a shark and that basking sharks tend to decay into plesiosaur-like shapes. Unfortunately, he tucked these comments into footnotes, while the body of the text encouraged the plesiosaur interpretation. Todd Wood recently provided an excellent summary of the evidence favoring a shark, and cautioned

fellow creationists about citing the carcass as a likely plesiosaur, but listed several "inconsistencies" with the shark ID—none of which is valid when closely examined.

As expected, the New Zealand monster story has also drifted onto the Internet, in both mangled and accurate forms. Creationists Kent Hovind (1996), Walter Brown (1996), Bernard Northrup (1997), Paul Smithson (1996), and Don Patton (1995) all encourage the plesiosaur interpretation. Brown matter-of-factly calls the creature a plesiosaur, which he incorrectly calls a sea-going "dinosaur." He also notes that the carcass had vertebrae, asserting these are "something not present in many fish, including sharks." (Of course fish, including sharks, do have vertebrae). In contrast, *Strange Magazine*'s "globsters" web site provides fairly accurate summaries of the Zuiyo-maru carcass and several other carcass strandings. An even better summary is provided by Roesch (1997a).

## Recommendations to Future Monster Finders

Before closing, a word of friendly advice is offered to anyone who might come upon an unidentified sea creature in the future. Although it is fortunate that Yano thought to take tissue samples, had he or others on board saved the animal's head or even a vertebra (which could have been sealed in a bucket or other container to avoid fish contamination), much time, effort, and speculation could have been avoided. In most cases even a single skeletal element would allow scientists to readily identify an unknown creature. It also would have been wise to take more photos, including close-ups of the head and other body parts, rather than just a few distant shots. That these things were not done suggests that the crew did not even suspect the creature could be a plesiosaur until others later suggested this. After all, even among a group of fishermen someone should have realized that a prehistoric "sea-monster" would be worth incalculably more both financially and scientifically than a load of mackerel.

As it turned out, there is little doubt that they actually caught a decomposed shark. Nevertheless, it is possible that unknown creatures do still lurk in the ocean depths. As evidence, only five months before the Zuiyo-maru incident a naval research vessel near Hawaii accidentally snagged a bizarre, 4.5-meter-long shark in its parachute-like sea-anchor. The curious fish had an unusually large head and wide, bowl-shaped jaws—features which soon earned it the nickname "megamouth." Its jaws were filled with hundreds of tiny teeth, and opened at the top rather than at the bottom as in most other sharks. Even stranger, the inside of the mouth seemed to glow with a silvery light. Apparently megamouth uses its reflective mouth tissue to attract tiny crustaceans while feeding in deep water, where little sunlight penetrates. Eventually the odd selachian was given the scientific name *Megachasma pelagios* and was determined to represent a new species, genus, and family of shark (Welfare and Fairley 1980; Soule 1981). Coincidentally, the megamouth is now considered a close relative of the basking shark.

## Conclusions

Several lines of evidence strongly indicate that the Zuiyo-maru carcass was a large shark, and most likely a basking shark, rather than a plesiosaur. Those giving the opposite impression have done so by telling only part of the whole story, or mischaracterizing portions of the evidence. To help set the record straight, such authors should correct any past misleading statements on this issue and refrain from any further suggestions that the carcass was a likely plesiosaur.

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